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IMMEDIATE LEARNING REINFORCEMENT IN A COMPLEX MENTAL-MOTOR SKILL, (DRIVER TRAINING) USING MOTION PICTURES - PHASE III. FINAL REPORT.

BY- CURTIS, CARROLL A. HAYES, ROBERT B.
PENNSYLVANIA STATE DEPT. OF PUBLIC INSTRUCTION

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PREVIOUS RESEARCH HAD SHOWN THAT SIMULATION COULD BE SUBSTITUTED FOR THREE OF SIX HOURS OF ACTUAL DRIVING INSTRUCTION, A CONCENTRATED COURSE OF INSTRUCTION COULD BE MORE EFFECTIVE THAN ONE OF SEVERAL WEEKS OR MONTHS, AND USE OF SIMULATOR MOVIES WITHOUT THE EQUIPMENT HAD VALUE. IN THIS STUDY, DATA ON HIGH SCHOOL STUDENTS IN HARRISBURG, PENNSYLVANIA WERE COLLECTED--AGE, SEX, GRADE AVERAGE, ATTITUDE, INTELLIGENCE, AND HOURS OF DRIVING OUTSIDE OF CLASS. PARTICIPANTS WERE RANDOMLY ASSIGNED TO ONE OF FIVE LEARNING SITUATIONS WITH VARYING LENGTHS OF PROGRAMS, AND USES OF SIMULATOR MOVIES AND EQUIPMENT, AND BEHIND-THE-WHEEL TRAINING. OTHER VARIABLES CONSIDERED IN EVALUATING TRAINING RESULTS WERE SCORES ON THE NEYHART ROAD SKILL CHECK LIST FOR PASSENGER CAR DRIVERS, THE NUMBER OF TIMES NEEDED TO PASS THE STATE DRIVING TEST, AND NUMBER OF TRAFFIC VIOLATIONS. STATISTICAL TECHNIQUES USED TO TEST FOR SIGNIFICANCE WERE COEFFICIENTS OF CORRELATION, CHI SQUARE, AND ANALYSIS OF VARIANCE AND COVARIANCE. IT WAS CONCLUDED THAT--(1) INSTRUCTIONAL TIME COULD BE REDUCED FROM NINE TO SIX HOURS IN THE SIMULATOR AND FROM SIX TO FOUR HOURS BEHIND THE WHEEL, AND (2), SIMULATOR MOVIES SHOWN WITHOUT EQUIPMENT WERE VALUABLE IN DEVELOPING DRIVING SKILLS, ATTITUDES, AND KNOWLEDGE. (APPENDIXES INCLUDE TESTS AND SEVERAL TABLES.) (PT)

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# "Immediate Learning Reinforcement in a Complex Mental - Motor Skill (Driver Training) Using Motion Pictures - Phase III"

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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# "IMMEDIATE LEARNING REINFORCEMENT IN A COMPLEX MENTAL - MOTOR SKILL (DRIVER TRAINING) USING MOTION PICTURES - PHASE III"

FINAL REPORT
Project No. 6-2179
Grant No. OEG-1-6-062179-0688

Authors

Carroll A. Curtis
Robert B. Hayes

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Bureau of Research
Department of Public Instruction
Harrisburg, Pennsylvania

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# INTRODUCTION

## THE PROBLEM

During the 1963-64 school year, a study of immediate learning reinforcement in driver education had indicated that nine hours of simulation could be substituted for three hours of the usual six hours of behind-the-wheel dual-control car instruction. Since in a dual-control car there is either a 2 to 1 or a 3 to 1 student-teacher ratio, the new simulator with its 12 to 1 student-teacher ratio appeared to be a means whereby many more students could be trained per instructor per year.[1]

A continuation of the project during the 1964-65 school year indicated that a concentrated course of instruction was more effective than a course spread over several weeks or months. Indications were also found that use of the simulator movies in a regular classroom without the other simulator equipment has value. Also, evidence was obtained in which six-hour and three-hour simulation courses, both of which were integrated with four hours of dual-control car behind-the-wheel instruction, compared favorably with a nine-hour simulator course which was integrated with four hours of behind-the-wheel dual-control car instruction. In addition, further evidence was gathered supporting the results of the first year's study that each instructor can effectively and efficiently train more pupils with the simulator equipment.[2]

The simulator in question presents instructional films which have been connected electronically with each of twelve simulated cars. A standardized programmed sequence from easy to difficult tasks is provided by twelve movies with immediate learning reinforcement of the same nature, time, and place. If the student reacts incorrectly to the traffic situation depicted by the motion picture, a warning red light appears on the student's private error identification panel. Then the student must correct the error in speed, steering, turn signals, brakes, or headlights. The student knows that he is performing correctly when no red lights appear. Thus, the reinforcement is immediate.

The 1965-66 project is the final phase of a three-year driver education study. The 1965-66 project sought to further explore substitution of simulated experience for actual practice driving, use of simulator movies in a regular classroom setting, and the effect of the length of the training period.

## OBJECTIVES

This experiment sought to answer these questions:

1. Can the instructional time in the simulator be reduced from nine to six hours without decreasing learning effectiveness?

2. Can the instructional time in the simulator be reduced from nine to three hours without decreasing learning effectiveness?

3. Will the simulator films, without the use of the simulator, help develop driving skills?

4. Will the simulator films, without the use of the simulator, do as much to improve attitude toward driving safety as does the other treatments to be used in this experiment?

5. Will the simulator films, without the use of the simulator, do as much to improve knowledge of driving as does the other treatments to be used in this experiment?

## METHOD

### POPULATION

This final phase of the study involved high school students from the William Penn and John Harris high schools of Harrisburg, Pennsylvania, a city of approximately 100,000 people. Harrisburg, the state capitol of Pennsylvania, has a variety of industries and a wide range of socio-economic levels.

### GENERAL DESIGN AND TREATMENTS

Students were assigned randomly to the treatment conditions which were as follows:

Treatment A: During the regular school year 159 students received the conventional program of six hours of behind-the-wheel training, six hours of observation in a dual-control car, and thirty hours of classroom instruction with up to 35 students. During the classroom instruction the

simulator films were shown without the use of the other simulator equipment. The movies were preceded by introductory remarks by the instructor and followed up with a test (Appendix A) and discussion of the objectives. The program was integrated to provide observation and driving experience concurrent with the classroom instruction.

Treatment B: During the regular school year 147 students received a simulator instruction program consisting of nine hours in the simulator, four hours of car observation, four hours of behind-the-wheel training and thirty hours of classroom instruction. The simulator movies were used only in the simulator. To assure a uniformly integrated program of instruction the following structured program was followed:

| Period | Number of Minutes | Content |
|---|---|---|
| 1 | 45 | "Introductory Film" |
| 2 | 45 | "Start of Good Driving" - (twice) |
| 3 | 40 | ½ driving, ½ observation |
| 4 | 40 | ½ driving, ½ observation |
| 5 | 45 | "The Good Turn" - (twice) |
| 6 | 45 | "City Driving" and "Highway Driving" |
| 7 | 40 | ½ driving, ½ observation |
| 8 | 40 | ½ driving, ½ observation |
| 9 | 45 | "Advanced City Driving" - (twice) |
| 10 | 45 | "Expressways" and "Shift for Yourself" |
| 11 | 40 | ½ driving, ½ observation |
| 12 | 40 | ½ driving, ½ observation |
| 13 | 45 | "Shift for Yourself" and "Parking" |
| 14 | 45 | "Driving After Dark" |
| 15 | 40 | ½ driving, ½ observation |
| 16 | 40 | ½ driving, ½ observation |
| 17 | 45 | "Let's Review" |
| 18 | 40 | ½ driving, ½ observation |

Treatment C: During the summer and fall of 1966, 64 students received an accelerated simulator instruction program integrating six hours in the simulator, four hours of car observation, and four hours of behind-the-wheel instruction. The pupils reacted to the first eight simulator movies only.

Treatment D: During the summer and fall of 1966, 52 students received an accelerated simulator instruction program integrating three hours in the simulator, four hours of car observation and four hours of behind-the-wheel instruction. These pupils reacted to the first five simulator movies only.

Treatment E: During the summer and fall of 1966, 55 students received an accelerated non-simulator program consisting of six hours of car observation and six hours of behind-the-wheel instruction. These students did not see any simulator films.

In all cases of simulator instruction (Treatments B, C, and D), the integrated teaching approach was used to facilitate transfer from simulation to the dual-control car. Each movie was introduced with approximately a four-minute briefing to clarify objectives and to motivate students. Students were directed to raise their hands when in trouble so that individual help could be given. When either several hands were raised simultaneously or many red lights flashed in the same area at the same time, the movie was stopped so the difficulty could be clarified by the teacher. Then the film was continued at an appropriate place. After each movie, important points were emphasized and students were advised of their errors by red light areas which had been recorded by the master error counter for each of the twelve learning stations.

## PRE-EXPERIMENTAL VARIABLES

The pre-course instruments for students in Treatments A and B were the Lorge-Thorndike Intelligence Test, the Siebrecht Attitude Scale, the 1962 Knowledge Test of the American Automobile Association, and a knowledge test (See Appendix B) devised by the involved instructors. For all students, data was collected for sex, age, and prior year's grade average. Hours of driving outside the school course were obtained from students.

## CRITERION VARIABLES

Both knowledge tests (named above), the Siebrecht Attitude Scale and an attitude scale devised by the principal investigator (Appendix B, pages B-5 through B-10) were administered to students in Treatments A and B at the end of the 1965-66 school year. Also, a record of simulator errors was maintained for each simulator student for each movie. A modified Neyhart Road Skill Check List for Passenger Car Drivers was completed by one of two independent judges during both the fourth and final twenty-minute periods of behind-the-wheel of a dual-control car. The Neyhart rating scale (See Appendix C) had been modified to delete items which did not pertain to either an automatic shift car or to the particular road course used in this experiment. Another criterion was the number of times each student needed to pass the State Operators License Examination. In addition, accident and traffic violations were analyzed.

## CONTROL OF TEACHER VARIABLE

The two driving instructors at each high school both taught approximately the same number of students by Treatments A and B during the regular school year. During the summer and fall a team teaching approach was employed for Treatments C, D and E. Each instructor received the same amount of supervision and training. All four instructors had used the simulator during the preceding two school years.

## CONTROL OF SEX VARIABLE

Sex differences were controlled by attempting to have the same number of boys and girls trained by each instructor and in each treatment. The actual number of pupils by sex and treatment were:

| Treatment | Boys | Girls | Total |
|---|---|---|---|
| A | 80 | 79 | 159 |
| B | 79 | 68 | 147 |
| C | 30 | 34 | 64 |
| D | 28 | 24 | 52 |
| E | 33 | 22 | 55 |
| Total | 250 | 227 | 477 |

A chi square test on the above indicated that there was no significant difference by sex in the various treatment conditions.

## ANALYSIS OF DATA

Statistical techniques utilized to test for significance were coefficients of correlation, chi square, and analysis of variance and covariance. Correlation procedures were used to test relationships between the variables of IQ, attitude, knowledge, age, grade average, simulator errors, driving errors, etc. Chi square was employed to test sex ratio by treatment and times to pass the State Operators License Examination by treatment condition. Either analysis of variance or covariance was used to compare the treatment conditions on knowledge, attitude, and driving errors.

# RESULTS

## PRE-EXPERIMENTAL VARIABLES

Analysis of variance of the pre-experimental variables yielded no significant differences among treatments. A description of this data is included in Appendix D.

## COEFFICIENTS OF CORRELATION

Statistically significant coefficients of correlation obtained in this study were as follows:

| Variables | r |
|---|---|
| Hours Outside Driving and Fourth Period Total Errors | -.21 |
| Hours Outside Driving and Final Period Total Errors | -.22 |
| Hours Outside Driving and Times to Pass State Operators Skills Test | -.31 |
| IQ and Harrisburg Post-Knowledge Test | .35 |
| IQ and AAA Post-Knowledge Test | .44 |
| IQ and Siebrecht Post-Attitude Test | .38 |
| Preceding Year Grade Average and Harrisburg Post-Knowledge Test | .20 |
| Preceding Year Grade Average and AAA Post-Knowledge Test | .26 |
| Preceding Year Grade Average and Siebrecht Post-Attitude Test | .32 |
| Fourth and Final Period Total Errors | .70 |
| Fourth Period Errors and Times to Pass State Operators Skills Test | .19 |
| Final Period Errors and Times to Pass State Operators Skills Test | .26 |
| IQ and Hayes Attitude Scale | .17 |

## FOURTH PERIOD DUAL-CONTROL CAR ERRORS

Which treatment condition better prepared the student for the fourth period of practice driving in the dual-control car? The following tables list the mean number of errors with standard deviations for each treatment group for the fourth driving period, according to the type of error - steering, braking, turn signals, speed, and total. The error categories were selected to correspond with the reinforcement mechanism of the simulator. Analysis of variance was used to test the significance of the differences between

means. The Tukey A Multiple Range Comparison was employed to test for differences between individual pairs of means where a significant F was found in the analysis of variance.

TABLE I

FOURTH PERIOD STEERING ERRORS

| | (A) Non Simulator* | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 6.75 | 6.39 | 9.73 | 8.69 | 13.27 |
| Standard Deviation | 11.29 | 8.71 | 13.01 | 11.00 | 15.69 |

*Treatment A viewed the simulator movies in the regular classroom.

Analysis of variance yielded an F ratio of 4.57 which exceeds the tabled value of 3.36 at the .01 level of significance for df 4,472. The Tukey A Comparison indicated that Treatment E has significantly more errors than either A or B at the .01 level. All other individual comparisons are not significant.

TABLE II

FOURTH PERIOD BRAKING ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 2.63 | 2.83 | 3.73 | 3.98 | 5.24 |
| Standard Deviation | 4.63 | 5.02 | 6.65 | 5.90 | 6.93 |

Analysis of variance yielded an F ratio of 2.85 exceeding the tabled value of 2.39 at the .05 level of significance for df 4,472. The Tukey A Comparison indicated that Treatment E has significantly more errors than either A or B at the .05 level. All other individual comparisons are not significant.

TABLE III

FOURTH PERIOD TURN SIGNAL ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | .36 | .19 | .31 | .27 | .36 |
| Standard Deviation | 1.17 | .71 | .89 | .69 | .87 |

Analysis of variance yielded an F ratio of .786 which is less than the tabled value of 2.39 at the .05 level of significance for df 4,472. Therefore there are no significant differences.

TABLE IV

FOURTH PERIOD SPEED ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | .77 | .87 | 1.80 | 1.10 | 3.25 |
| Standard Deviation | .25 | 3.13 | 4.57 | 2.82 | 5.58 |

Analysis of variance yielded an F ratio of 6.08 exceeding the tabled value of 3.36 at the .01 level of significance for df 4,472. The Tukey A Comparison indicated that Treatment E had significantly more errors than either A, B, or D at the .01 level and significantly more errors than C at the .05 level. All other individual comparisons are not significant.

TABLE V

FOURTH PERIOD TOTAL ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 14.62 | 13.77 | 20.58 | 17.90 | 26.44 |
| Standard Deviation | 15.64 | 12.08 | 20.53 | 16.31 | 21.61 |

Analysis of variance yielded an F ratio of 7.14 exceeding the tabled value of 3.36 at the .01 level of significance for df 4,472. The Tukey A Comparison indicated that Treatment E has significantly more errors than either A or B at the .01 level and significantly more errors than D at the .05 level. All other individual comparisons are not significant.

FINAL PERIOD DUAL-CONTROL CAR ERRORS

Which treatment condition better prepared students for the final period of practice driving in the dual-control car? The following tables list the average number of errors and standard deviations for the final driving period in accordance with the previous analysis.

TABLE VI

FINAL PERIOD STEERING ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 3.33 | 3.33 | 5.27 | 5.77 | 4.24 |
| Standard Deviation | 6.93 | 4.91 | 7.13 | 6.97 | 5.45 |

Analysis of variance yielded an F ratio of 2.87 exceeding the tabled value of 2.39 at the .05 level of significance for df 4,472. The Tukey A Comparison indicated that Treatment D has significantly more errors than either A or B at the .05 level. All other individual comparisons are not significant.

TABLE VII

FINAL PERIOD BRAKING ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 1.47 | 1.12 | 1.36 | 1.67 | 1.78 |
| Standard Deviation | 3.44 | 2.76 | 2.97 | 3.68 | 3.97 |

Analysis of variance yielded an F ratio of .57 which is less than the tabled value of 2.39 at the .05 level of significance for df 4,472. Therefore there are no significant differences.

TABLE VIII

FINAL PERIOD TURN SIGNAL ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | .89 | .75 | .94 | .83 | .69 |
| Standard Deviation | 1.78 | 1.56 | 1.78 | 2.08 | 1.45 |

Analysis of variance yielded an F ratio of .289 which is less than the tabled value of 2.39 at the .05 level of significance for df 4,472. Therefore there are no significant differences.

TABLE IX

FINAL PERIOD SPEED ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 1.57 | 1.76 | 1.45 | 1.94 | 2.09 |
| Standard Deviation | 4.26 | 4.10 | 4.24 | 3.86 | 4.88 |

Analysis of variance yielded an F ratio of .25 which is less than the tabled value of 2.39 at the .05 level of significance for df 4,472. Therefore there are no significant differences.

TABLE X

FINAL PERIOD TOTAL ERRORS

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average No. of Errors | 10.60 | 10.14 | 13.09 | 13.96 | 12.75 |
| Standard Deviation | 11.26 | 12.31 | 12.75 | 14.45 | 11.91 |

Analysis of variance yielded an F ratio of 1.600 which is less than the tabled value of 2.39 at the .05 level of significance for df 4,472. Therefore there are no significant differences.

KNOWLEDGE TEST SCORES

Which treatment condition, A or B, better prepared the students in the knowledge of driving? The following tables list the pre- and post-test mean scores and standard deviations for the American Automobile Association Knowledge Test and the Harrisburg Knowledge Test (See Appendix B).

TABLE XI

AAA KNOWLEDGE TEST

| | Pre-Test | | Post-Test | |
|---|---|---|---|---|
| | (A) Non Simulator | (B) 9-Hr. Simulator | (A) Non Simulator | (B) 9-Hr. Simulator |
| Mean Scores | 11.16 | 11.10 | 13.01 | 12.77 |
| Standard Deviation | 2.81 | 2.79 | 2.58 | 2.82 |

Analysis of covariance on the post-test using the pre-test as a covariate yielded an F ratio of .42 which is less than

the tabled value of 3.86 at the .05 level of significance for df 1,304. Therefore there is no significant difference. A correlation of .47 was obtained between the pre-test and post-test AAA Knowledge Test scores.

TABLE XII

HARRISBURG KNOWLEDGE TEST

| | Pre-Test | | Post-Test | |
|---|---|---|---|---|
| | (A) Non Simulator | (B) 9-Hr. Simulator | (A) Non Simulator | (B) 9-Hr. Simulator |
| Mean Scores | 31.87 | 32.86 | 37.28 | 37.83 |
| Standard Deviation | 5.10 | 4.23 | 4.20 | 4.35 |

Analysis of covariance on the post-test using the pre-test as the covariance yielded an F ratio of .03 which is less than the tabled value of 3.86 at the .05 level of significance for df 1,304. Therefore there is no significant difference between treatments. A correlation of .48 between pre-test and post-test scores was obtained.

ATTITUDE TEST SCORES

Which treatment condition, A or B, resulted in a more favorable attitude toward driving safety? The following tables list the pre- and post-test mean scores and standard deviations for the Siebrecht Attitude Scale and the locally devised (Hayes Scale - See Appendix B, pages B-5 through B-10) attitudinal scale.

TABLE XIII

SIEBRECHT ATTITUDE SCALE

| | Pre-Test | | Post-Test | |
|---|---|---|---|---|
| | (A) Non Simulator | (B) 9-Hr. Simulator | (A) Non Simulator | (B) 9-Hr. Simulator |
| Mean Scores | 27.12 | 27.25 | 30.23 | 29.50 |
| Standard Deviation | 6.10 | 5.92 | 5.90 | 6.36 |

Analysis of covariance on the post-test using the pre-test as a covariate yielded an F ratio of 1.70 which is less than the tabled value of 3.87 for the .05 level of significance df 1,304. Therefore there is no significant difference. A correlation of .48 was obtained between the pre-test and post-test Siebrecht Scales.

TABLE XIV

HAYES ATTITUDE SCALE

| | (A) Non Simulator | (B) 9-Hr. Simulator |
|---|---|---|
| Mean Scores | 15.13 | 16.25 |
| Standard Deviation | 4.83 | 5.42 |

Analysis of variance yielded an F ratio of 3.64 which is less than the tabled value of 3.87 for the .05 level of significance for df 1,304. Therefore there is no significant difference.

The original fifty-item Hayes Attitude Scale was administered to all pupils in treatments A and B as a post-test only. The scores were then divided by fifths according to total score and a differentiation index computed for each of the fifty items. Analysis of variance was performed only on those sixteen items with a differentiation index of .31 or higher. The statement number and the differentiation index for each of the sixteen items is as follows:

| Statement No. | Diff. Index | Statement No. | Diff. Index |
|---|---|---|---|
| 7 | .45 | 24 | .51 |
| 8 | .35 | 30 | .43 |
| 10 | .55 | 32 | .37 |
| 12 | .49 | 37 | .49 |
| 14 | .47 | 38 | .37 |
| 16 | .37 | 39 | .33 |
| 19 | .39 | 42 | .51 |
| 20 | .31 | 43 | .35 |

SKILLS SECTION OF OPERATORS LICENSE EXAM

Which treatment better prepared students to pass the driving skills part of the State License Examination?

TABLE XV

TIMES TO PASS STATE SKILLS TEST

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average Times to Pass | 1.52 | 1.60 | 1.37 | 1.29 | 1.33 |
| Standard Deviation | .66 | .95 | .39 | .60 | .47 |

Analysis of variance yielded an F ratio of 2.981, exceeding the tabled value of 2.39 for the .05 level of significance at df 4,465. The Tukey A Comparison indicates that Treatment B took significantly more times to pass the Skills Test than Treatment D at the .05 level. All other individual comparisons are not significant.

WRITTEN SECTION OF OPERATORS LICENSE EXAM

Which treatment better prepared students to pass the written part of the State License Examination?

TABLE XVI

TIMES TO PASS STATE WRITTEN TEST

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average Times to Pass | 1.13 | 1.22 | 1.17 | 1.08 | 1.02 |
| Standard Deviation | .35 | .52 | .38 | .27 | .24 |

Analysis of variance yielded an F ratio of 3.115 which exceeds the tabled value of 2.39 for the .05 level of significance for df 4,468. The Tukey A Comparison indicates that Treatment B took significantly more times to pass the written exam than E at the .05 level. All other individual comparisons are not significant.

## SKILLS TEST PERFORMANCE BY TREATMENT AND SEX

In the first year of the study the girls, but not the boys, had a significantly higher probability of passing the State Operators License Skills Test the first time if they had learned to drive with an integrated simulator approach.[1] In the second year of the study there was no significant difference among treatment groups for either the boys or the girls.[2] During this, the third year of the study, there again was no significant difference among treatments on the number of students passing the Skills Test on the first attempt for either boys or girls. The chi square values obtained were, for girls, 1.395 and for boys 2.801; both less than the tabled value of 9.488 for the .05 level of significance for df 4. The following table lists the per cent in each treatment group by sex that passed the State Operators License Skills Test the first time.

TABLE XVII

PER CENT BY SEX PASSING THE STATE SKILLS TEST FIRST TIME

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Boys | 65 | 58 | 82 | 75 | 67 |
| Girls | 49 | 49 | 52 | 57 | 68 |

Collectively 66 per cent of the boys and 52 per cent of the girls passed the Skills Test the first time.

## ACCIDENTS AND MOVING TRAFFIC VIOLATIONS DURING THE 3-YEAR STUDY

During the 1963-64 school year, two hundred high school students were taught with a conventional driver education course, utilizing six hours of behind-the-wheel instruction, six hours in the dual-control car, and conventional classroom instruction. One hundred students were taught in a simulator integrating the dual-control car training with the simulation, and one hundred students were taught with a non-integrated simulator approach.[1] The number of accidents (where the drivers were at least partly at fault) and moving traffic violations for each treatment group as of March 15, 1967, which represents about three years of driving, is as follows:

| GROUPS | N | NUMBER OF ACCIDENTS | NUMBER OF VIOLATIONS | TOTAL |
|---|---|---|---|---|
| Non-Simulator | 200 | 11 | 43 | 54 |
| Integrated Simulator | 100 | 1 | 19 | 20 |
| Non-Integrated Simulator | 100 | 5 | 23 | 28 |
| Total | 400 | 17 | 85 | 102 |

A chi square analysis on the number of accidents yielded a value of 3.353 which was less than the tabled value of 5.911 for the .05 level of significance at df 2, therefore not significant. A similar analysis on number of violations yielded a chi square value of .026, which also is not significant.

During the 1964-65 school year, 167 students received a non-simulator conventional course except that the simulator movies were shown in the regular classroom. One hundred sixty-one students received a nine-hour integrated simulator course; 75 students received a six-hour integrated simulator course; and 62 students received a three-hour integrated simulator course.[2] The number of accidents and moving traffic violations for each treatment group as of March 15, 1967, which represents about two years of driving, is as follows:

| GROUPS | N | NUMBER OF ACCIDENTS | NUMBER OF VIOLATIONS | TOTAL |
|---|---|---|---|---|
| Non-Simulator | 167 | 6 | 23 | 29 |
| 9-Hr. Simulator | 161 | 2 | 15 | 17 |
| 6-Hr. Simulator | 75 | 1 | 4 | 5 |
| 3-Hr. Simulator | 62 | 0 | 7 | 7 |
| Total | 465 | 9 | 49 | 58 |

Because of the extremely low number of cases (all expected values less than five even after combining classes), a meaningful analysis of number of accidents was not possible.

A chi square analysis on the number of violations yielded a value of 3.845 which was less than the tabled value of 7,815 for df 3, P .05; therefore, it is not significant.

Pupils trained during the 1965-66 regular school year as described earlier in this report as Treatment A (non-simulator) and Treatment B (9-hour simulator) were compared on the number of accidents and moving traffic violations as of March 15, 1967, which represents about one year of driving. The results were as follows:

| GROUPS | N | NUMBER OF ACCIDENTS | NUMBER OF VIOLATIONS | TOTAL |
|---|---|---|---|---|
| Non-Simulator | 159 | 4 | 8 | 12 |
| 9-Hr. Simulator | 147 | 4 | 6 | 10 |
| Total | 306 | 8 | 14 | 22 |

There are no significant differences in either number of accidents or number of violations.

SIMULATOR ERRORS COMPARED TO FINAL DRIVING PERIOD ERRORS

Coefficients of correlation were computed between each simulator error category and the corresponding error category in the final driving period in the dual-control car. The results are as follows:

| Variables | r |
|---|---|
| Average Simulator Steering Errors and Final Period Steering Errors | .18** |
| Average Simulator Braking Errors and Final Period Braking Errors | .11 |
| Average Simulator Turn Signal Errors and Final Period Turn Signal Errors | .16** |
| Average Simulator Speed Errors and Final Period Speed Errors | .08 |
| Average Simulator Total Errors and Final Period Total Errors | .21** |

**Significant at the .01 level Tabled value .159 for n=263
The tabled value for the .05 level of significance is .121 for n=263.

## DISCUSSION

During the course of the experiment it was found that the goal of ten days for the completion of the accelerated programs (Treatments C, D, and E) was not within reach because of scheduling difficulties. However, the following table illustrates that Treatments C, D, and E on the average completed the course in approximately the same number of days and about one-half the average days for Treatments A and B to complete the course. Treatments A and B do not differ appreciably from each other on the days to complete. Therefore, the aim of the time differential was achieved in principle if not in precisely the same terms as proposed.

TABLE XVIII

DAYS TO COMPLETE COURSE

| | (A) Non Simulator | (B) 9-Hr. Simulator | (C) 6-Hr. Simulator | (D) 3-Hr. Simulator | (E) Accelerated Non-Simulator |
|---|---|---|---|---|---|
| Average Days to Complete | 43.03 | 47.89 | 24.75 | 22.06 | 22.83 |
| Standard Deviation | 16.08 | 10.56 | 9.20 | 10.28 | 11.39 |

Analysis of the times to pass the State Operators Written and Skills Tests yielded some significant differences at the .05 level favoring Treatment B. These differences are difficult to explain and may be chance deviations since they were not supported in either of the first two years of the study.

The evidence on the relative value of the three-hour simulator Treatment D was ambiguous. Pupils in Treatment D made significantly more errors (.05 level) than pupils in Treatment B or A on final period steering errors. Yet pupils in Treatment D passed the State Operators Skills Test in significantly (.05 level) fewer times than did pupils in Treatment B.

## CONCLUSIONS

This study apparently indicates that:

1. Instructional time can be reduced from nine to six hours in the simulator and from six to four hours behind the wheel of a dual-control car provided the simulator and dual-control car instruction is integrated.

2. The use of the simulator movies in a regular classroom without the other simulation equipment is of value in developing driving skills, attitudes and knowledge provided before each film students are advised that a written quiz and discussion will follow immediately to emphasize the learning objectives.

## IMPLICATIONS

Simulation with standardized immediate learning reinforcement can be used successfully in driver education. Completely non-simulator pupils may be expected to make more errors than simulator pupils, particularly in the initial periods of practice driving. The evidence on subsequent accidents and moving traffic violations tends to favor the simulator-trained student although the results to date have not been statistically significant. Further study in large school systems with desirable scheduling flexibility should be performed to take advantage of the increased number of students per instructor which is inherent in a simulator course compared to a conventional driver training program.

## REFERENCES

### Reference Reports


1. Hayes, Robert B. et. al. Immediate Standardized Learning Reinforcement to a Complex Mental - Motor Skill (Driver Training) Using Electronically-Coordinated Motion Pictures. Bureau of Research, Department of Public Instruction, Harrisburg, Pennsylvania, 1964.

   Hayes, Robert B. et. al. Immediate Learning Reinforcement in a Complex Mental - Motor Skill (Driver Training) Using Motion Pictures - Phase II. Bureau of Research, Department of Public Instruction, Harrisburg, Pennsylvania, 1964-65.

## APPENDIX A

## FILM CONTENT QUIZZES

### I. START OF GOOD DRIVING

Number the following steps in the Starting Procedure in their correct order.

1. _____ Acceleration
2. _____ Selector Lever to "Neutral"
3. _____ Release Parking Brake
4. _____ Selector Lever to Drive
5. _____ Take Slack from Foot Brake
6. _____ Start Engine
7. _____ Signal
8. _____ Check Traffic, Front, Sides and Rear

Number the following steps in the Stopping Procedure in their correct order.

1. _____ Check Traffic Behind
2. _____ Lane Position
3. _____ Signal
4. _____ Release Gas Pedal
5. _____ Brake Lightly
6. _____ Slight Hand and Wheel Movement Toward Curb
7. _____ After Stopping Set Hand Brake

## II. THE GOOD TURN

True or False

1. A turn signal must always precede a left or right turn.

2. The front wheels turn the same way as the steering wheel.

3. To signal for a left turn the signal lever is up.

4. When turning at an intersection you should enter the lane that corresponds to the lane that you left.

5. It is good driving procedure to brake while making a turn.

6. Cars making a left turn have the right of way over traffic coming straight through the intersection.

7. Right turns are always made from the extreme right lane.

8. Speed should be reduced before starting to make a turn.

9. When turning hand over hand the fingers may be placed under the steering wheel.

10. A good turn recovery can be made by letting the wheel slide back through your hands.

## III. CITY DRIVING

Completion - write in the word or words to complete the following statements:

_____1. As speed increases, following distance should _____proportionately.

_____2. A safe following distance can be determined by allowing one car length for each_____ miles per hour.

_____3. On a one-way street a left turn is made from the_____lane.

_____4. A complete stop may not be necessary at an intersection controlled by a_____ sign.

_____5. Turning the wheel too much on a slight curve is called_____.

_____6. When passing a line of parked cars always watch out for the_____on the traffic side.

_____7. A turning vehicle must always yield the right of way to_____.

_____8. A good driver should always anticipate danger by _____the_____.

_____9. Before changing lanes always check traffic and _____.

_____10. A good driver avoids traffic conflicts by_____ _____them in time to do something about it.

IV. HIGHWAY DRIVING

1. Busses and fuel carriers_____at railroad crossings.

2. List the proper procedure to follow when passing another vehicle.

   A.

   B.

   C.

   D.

   E.

   F.

3. Name three places where a driver is not allowed to pass another vehicle.

   A.

   B.

   C.

4. What should you do when you see an emergency vehicle approaching you on the highway?

5. List three factors that determine a safe speed for driving a motor vehicle.

   A.

   B.

   C.

6. It is always illegal to pass a parked school bus discharging students_____(True or False).

V. ADVANCED CITY DRIVING

1. List two benefits of one-way streets.

   A.

   B.

2. List two ways to identify one-way streets.

   A.

   B.

3. In heavy traffic, you should leave the vehicle from the _____side.

4. What should a driver do before changing traffic lanes?

   A.

   B.

5. List two problems that can be expected on one-way streets.

   A.

   B.

6. A left turn from a one-way street must be made from the _____lane.

7. On a three-lane, one-way street, the_____lane is usually the least congested and will move more traffic.

## VI. EXPRESSWAY DRIVING

1. Expressways are designed for safety. List three safety features:

   A.

   B.

   C.

2. All expressways have some potential dangers. List two hazards that can be expected.

   A.

   B.

3. What name is given to the lane leading off the expressway to an exit?

   _____

4. What name is given to the lane leading on to the expressway from an entry road?

   _____

5. At a cloverleaf intersection the first exit ramp is for a _____turn and the second exit ramp is for a _____turn.

6. How can you request assistance if you have a mechanical breakdown on the expressway?

   _____

APPENDIX B

HARRISBURG CITY SCHOOLS
Driver Education Knowledge Test

Name_____ Date_____

Instructor_____ Period_____

I. MULTIPLE CHOICE

Write the letter of the best answer in the blank at the left.

_____ 1. You must submit an accident report if you are involved in an accident where property damage exceeds (a) $25, (b) $50, (c) $100, (d) $500.

_____ 2. What does a traffic light flashing yellow indicate to you? (a) caution, (b) danger, (c) stop, (d) construction.

_____ 3. At a speed of 50 m.p.h., the total stopping distance is (a) 66 ft., (b) 111 ft., (c) 200 ft., (d) 166 ft.

_____ 4. The date on which registration plates expire for passenger cars is (a) January 31, (b) July 31, (c) March 31, (d) October 31.

_____ 5. A safe night-time speed is primarily determined by the limits of (a) headlights, (b) weather, (c) posted speeds, (d) traffic.

_____ 6. The first thing a driver must do when involved in an accident is (a) call police, (b) stop, (c) assist injured, (d) make report.

_____ 7. You are permitted to use the high beam headlights providing there are no cars approaching within (a) 200 ft., (b) 400 ft., (c) 500 ft., (d) 500 yds.

_____ 8. To make a left turn from a one-way street, a driver should place his car (a) along the left curb, (b) center lane, (c) right lane, (d) any lane.

_____ 9. The distance you must park your car from a fire hydrant is (a) 10 ft., (b) 15 ft., (c) 25 ft., (d) 30 ft.

_____10. A motor vehicle must be inspected (a) each month, (b) each year, (c) twice a year, (d) every two years.

_____11. Each inspection period lasts (a) one month, (b) three months, (c) six months, (d) one year.

_____12. You may park (a) 10 ft., (b) 15 ft., (c) 25 ft., (d) 30 ft. from a stop sign.

_____13. A traffic light flashing red means (a) stop, (b) slow, (c) danger, (d) men working.

_____14. The minimum distance of clear highway necessary for safe passing is (a) 200 ft., (b) 400 ft., (c) 500 ft., (d) 600 ft.

_____15. When a driver hears the siren of an approaching emergency vehicle, he should (a) slow down, (b) drive to the right, (c) stop, (d) drive to the right and stop.

_____16. When stopping for a school bus that has stopped on the highway, you must stop (a) 10 ft., (b) 20 ft., (c) 30 ft., (d) 50 ft. from the bus.

_____17. Driving an automobile in Pennsylvania is a (a) right, (b) duty, (c) privilege, (d) pleasure.

_____18. You must make an accident report within (a) 12 hrs., (b) 24 hrs., (c) 48 hrs., (d) 90 days.

_____19. In addition to his operator's license, a driver must have in his possession (a) insurance card, (b) vehicle registration card, (c) credit card, (d) social security card.

_____20. You may park no closer to a railroad crossing than (a) 10 ft., (b) 20 ft., (c) 30 ft., (d) 50 ft.

_____21. According to records, the most frequent cause of trouble on the road is (a) out of gas, (b) ignition, (c) tires, (d) carburetor.

_____22. The type of insurance most important for every car owner is (a) fire, (b) theft, (c) liability, (d) collision.

_____23. The shape of the traffic sign to indicate a railroad grade crossing is (a) oblong, (b) hexagonal, (c) round, (d) square.

_____24. As you increase speed, your danger zone (a) widens only, (b) lengthens only, (c) lengthens and widens, (d) shortens.

_____25. The traffic sign you expect as you enter an expressway is (a) yield, (b) slow, (c) stop, (d) one-way.

II. TRUE OR FALSE

Mark + for true and 0 for false.

_____26. As a rule motorists under 20 years of age are safer drivers than those over 40 years of age.

_____27. When you intend to turn or stop, the law does not require you to give a signal unless there is a vehicle following yours.

_____28. If you become sleepy while driving, it is best to drink coffee or take anti-doze pills.

_____29. If one side of the front tires are worn more than the other, the trouble is likely to be wheels out of alignment.

_____30. A driver who is emotionally immature is most likely to express anger by driving recklessly.

_____31. A common habit of a discourteous driver is to use the horn frequently.

_____32. In crossing slippery street car tracks, you should slow down and turn abruptly across the tracks at a wide angle.

_____33. When you back your car, you have the right of way because you cannot see very well while backing.

_____34. The amount of alcohol in one cocktail is sufficient to decrease one's keenness of vision.

_____35. It requires the same distance to slow down from 60 m.p.h. to 50 m.p.h. as it does from 40 m.p.h. to 30 m.p.h.

_____36. Defective eyesight will affect a driver more adversely in night driving than in day driving.

_____37. It is necessary to slow down at an unprotected intersection if you do not see any cross traffic.

_____38. If a driver seriously injures a pedestrian, legally at fault, the driver does not have to make an accident report.

_____39. When you drive out of a gas station, street traffic on your left has the right of way.

_____40. A rear view mirror can be relied upon for a complete view of what's behind your car.

_____41. You may legally exceed the speed limit when you are driving an injured person to the hospital.

_____42. More fatal accidents take place on clear, dry days than on stormy days.

_____43. New non-skid tires have done away with the danger of skidding on wet pavements.

_____44. If your temperature gauge does not reach normal after a mile of driving, it usually means a defective thermostat.

_____45. The odometer shows the condition of the car's battery.

_____46. A full fuel tank prevents water formed by condensation.

_____47. The function of the carburetor is to vaporize gasoline.

_____48. Field of vision is your ability to see from side to side.

_____49. Loss of oil pressure can cause permanent damage to the engine of a car.

_____50. Good depth perception is most important when passing another car.

## III. HAYES ATTITUDE SCALE

Statements about Driving.

1. Being a safe driver is very important to me.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

2. I like to decorate my car with gadgets.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

3. I never like advice from cops.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

4. When another driver follows close to my car, I let him pass.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

5. It's fun to make tires squeal when you drive.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

6. In my opinion, failure to plan ahead while driving is planning to have an accident.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

7. When I buy a car, its safety features will be the most important thing in my choice of cars.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

8. Most road signs permit maximum speeds which are at least ten miles an hour too slow.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

9. I like to scare the other drivers on the highway.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

10. I really enjoy driving quick like a jet.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

11. I think this whole business about safe driving is something I should help improve.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

12. I feel I can drive safely with one hand on the wheel.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

13. Traffic officers just do not deserve our cooperation.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

14. I worry about the possibility of killing someone when I drive a car.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

15. I like to drive faster than anyone else on the road.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

16. My driving skill really needs a lot of improvement.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

17. Required car inspections are a racket to help garage and service station people make money.

   A. Strongly Agree  B. Agree
   C. Disagree  D. Strongly Disagree

18. There are far too many traffic regulations.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

19. I worry about the possibility of injuring someone when I drive.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

20. I have a tendency to speed when I have others in the car.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

21. When I am really worried or angry about something, I will not drive.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

22. Seat belts are too much bother.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

23. A driver's license is a right in a democratic society.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

24. When I drive, I worry about the possibility of causing damage to some other person's car.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

25. I don't waste time stopping completely at stop signs.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

26. I really believe in physical fitness since it may help me drive better.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

27. I like to see how far I can make tires last even though the tread is thin.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

28. The State should require physical examinations of all drivers.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

29. When I drive, I do not take chances since I am concerned very much with the possibility of doing harm to someone else.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

30. I tend to go faster when I see another car in my rear view mirror.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

31. To me "safety first" is one of the most important things in the world.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

32. It would make me feel big to have a car that would go fast like a rocket.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

33. Cops like to give you tickets for even the little things.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

34. The more cars there are on the road, the more I drive as carefully as possible.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

35. I drive just as fast when roads are wet as when they are dry.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

36. Awards ought to be given to the drivers who have driven years without an accident.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

37. I want a sleek, shiny car that would go - go - go.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

38. I don't believe in using radar to trap you into an arrest.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

39. I sometimes pray for help so I will not have an accident.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

40. I pass slow drivers on the right side.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

41. I believe in doing everything in my power to promote highway safety.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

42. Cars are a dangerous weapon.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

43. Cops are too self-important.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

44. I really believe that drivers should help each other.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

45. I'll stay in line when there is a long line of cars ahead of me.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

46. Those who are at fault should be sent to jail if they are driving and kill a person.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

47. If I was short on cash, I might wait before fixing the brakes.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

48. I don't even try to obey all those traffic regulations.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

49. At night I try to be the first one to dim the lights when another car comes toward me.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

50. They ought to make me a highway patrolman since I enjoy driving at high speeds.

A. Strongly Agree B. Agree
C. Disagree D. Strongly Disagree

APPENDIX C

Modified Neyhart
ROAD TEST CHECK LIST
For Passenger Car Drivers

Name_____ Date_____

School_____ Checked by_____

Instructor_____ Total Deductions_____

| | | DE-DUCT | | | | |
|---|---|---|---|---|---|---|
| 1. | CHECKING THE DRIVER | | | | | |
| | A. Fails to adjust seat properly | 1 | ___ | ___ | ___ | ___ |
| | B. Fails to adjust rear view mirrors | 3 | ___ | ___ | ___ | ___ |
| | C. Fails to use seat belt | 3 | ___ | ___ | ___ | ___ |
| 2. | STARTING THE VEHICLE | | | | | |
| | A. Selects wrong gear or selector lever position | 3 | ___ | ___ | ___ | ___ |
| | B. Does not release parking brake | 1 | ___ | ___ | ___ | ___ |
| | C. Fails to use brake when moving selector lever | 3 | ___ | ___ | ___ | ___ |
| 3. | BACKING | | | | | |
| | A. Fails to look to the rear while backing | 5 | ___ | ___ | ___ | ___ |
| | B. Backs jerkily | 2 | ___ | ___ | ___ | ___ |
| | C. Oversteers and zigzags while backing | 2 | ___ | ___ | ___ | ___ |
| 4. | STEERING | | | | | |
| | A. Places hands in unstable position on wheel | 2 | ___ | ___ | ___ | ___ |
| | B. Steers abruptly, not smoothly | 5 | ___ | ___ | ___ | ___ |
| | C. Rests arm on window | 2 | ___ | ___ | ___ | ___ |
| | D. Uses one hand habitually | 2 | ___ | ___ | ___ | ___ |
| 5. | POSITION ON ROADWAY | | | | | |
| | A. Fails to drive in proper lane | 5 | ___ | ___ | ___ | ___ |
| | B. Straddles traffic lanes (marked or unmarked) | 5 | ___ | ___ | ___ | ___ |
| | C. Straddles at signal or sign when stopping | 5 | ___ | ___ | ___ | ___ |
| | D. Follows too close to other vehicles | 5 | ___ | ___ | ___ | ___ |
| | E. Drives too close to other vehicles, moving objects, etc. | 3 | ___ | ___ | ___ | ___ |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. | SPEED CONTROL | | | | | |
| | A. Too fast for conditions | 10 | ___ | ___ | ___ | ___ |
| | B. In excess of marked speed limits | 5 | ___ | ___ | ___ | ___ |
| | C. Too slow for conditions | 2 | ___ | ___ | ___ | ___ |
| | D. Brakes on curves | 5 | ___ | ___ | ___ | ___ |
| 7. | SIGNALLING FAILURES | | | | | |
| | A. Turning - fails to signal | 2 | ___ | ___ | ___ | ___ |
| | B. Leaves turn signal on after turning | 2 | ___ | ___ | ___ | ___ |
| | C. Does not signal moving from lane to lane | 2 | ___ | ___ | ___ | ___ |
| | D. Uses horn improperly or fails to use horn | 2 | ___ | ___ | ___ | ___ |
| 8. | SIGNAL VIOLATIONS | | | | | |
| | A. Traffic signal (through on amber) | 3 | ___ | ___ | ___ | ___ |
| | B. Traffic signal (through on red) | 10 | ___ | ___ | ___ | ___ |
| | C. Traffic officer | 10 | ___ | ___ | ___ | ___ |
| 9. | UNCONTROLLED INTERSECTIONS OR THROUGH STREETS | | | | | |
| | A. Fails to slow down with intent to stop if necessary | 3 | ___ | ___ | ___ | ___ |
| | B. Fails to look in all directions | 5 | ___ | ___ | ___ | ___ |
| | C. Fails to respond to hazardous traffic conditions in the making | 10 | ___ | ___ | ___ | ___ |
| | D. Fails to yield right of way | 10 | ___ | ___ | ___ | ___ |
| 10. | STOP STREETS | | | | | |
| | A. Fails to come to full stop | 10 | ___ | ___ | ___ | ___ |
| | B. Fails to stop in a position to see roadway to the right and left | 5 | ___ | ___ | ___ | ___ |
| | C. Hesitates too long for conditions | 3 | ___ | ___ | ___ | ___ |
| 11. | TURNING (Right) | | | | | |
| | A. Approaches from improper lane | 3 | ___ | ___ | ___ | ___ |
| | B. At improper speed (too fast or too slow) | 2 | ___ | ___ | ___ | ___ |
| | C. In improper lane during turn | 3 | ___ | ___ | ___ | ___ |
| | D. Into improper lane after turn | 3 | ___ | ___ | ___ | ___ |
| | E. Strikes curb | 3 | ___ | ___ | ___ | ___ |
| | F. Makes turn unnecessarily wide | 1 | ___ | ___ | ___ | ___ |
| | G. Shies away, then turns right | 2 | ___ | ___ | ___ | ___ |
| | H. Fails to yield right of way | 10 | ___ | ___ | ___ | ___ |

12. TURNING (Left)

| | | | | | |
|---|---|---|---|---|---|
| A. Approaches from improper lane | 3 | ___ | ___ | ___ | ___ |
| B. At improper speed (too fast or too slow) | 2 | ___ | ___ | ___ | ___ |
| C. In improper lane during turn | 3 | ___ | ___ | ___ | ___ |
| D. Into improper lane after turn | 3 | ___ | ___ | ___ | ___ |
| E. Cuts corner too short | 1 | ___ | ___ | ___ | ___ |
| F. Cuts corner too wide | 1 | ___ | ___ | ___ | ___ |
| G. Shies away, then turns left | 2 | ___ | ___ | ___ | ___ |
| H. Fails to yield right of way | 10 | ___ | ___ | ___ | ___ |

13. STOPPING

| | | | | | |
|---|---|---|---|---|---|
| A. Before necessary at signals and signs | 1 | ___ | ___ | ___ | ___ |
| B. Not soon enought (over-running crosswalk or avoidance zone line) | 2 | ___ | ___ | ___ | ___ |
| C. Not at a safe place (too close to other vehicles, etc.) | 5 | ___ | ___ | ___ | ___ |
| D. Stalls engine | 5 | ___ | ___ | ___ | ___ |

14. SMOOTHNESS OF OPERATION

| | | | | | |
|---|---|---|---|---|---|
| A. Uses brakes roughly or unevenly | 5 | ___ | ___ | ___ | ___ |
| B. Fails to hold accelerator steady | 5 | ___ | ___ | ___ | ___ |

15. PASSING OTHER VEHICLES GOING IN SAME DIRECTION

| | | | | | |
|---|---|---|---|---|---|
| A. Fails to make sure road ahead and behind is clear | 10 | ___ | ___ | ___ | ___ |
| B. Passes at intersection | 10 | ___ | ___ | ___ | ___ |
| C. Cuts back into line too soon after passing | 5 | ___ | ___ | ___ | ___ |
| D. Passes by weaving through traffic | 5 | ___ | ___ | ___ | ___ |

16.

| NERVOUS AND HESITANT | | OVERCONFIDENT | |
|---|---|---|---|
| Not at all | 0 | Not at all | 0 |
| Occasionally | 5 | Part of time | 5 |
| Often | 10 | Cocky | 10 |
| All the time | 15 | | |

FAILS TO USE REAR VIEW MIRRORS

| | |
|---|---|
| Not at all | 0 |
| Part of time | 3 |
| Over entire route | 5 |

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## APPENDIX D

## PRE-EXPERIMENTAL VARIABLES

| Variables | Treatments (A) Non Simulator | | (B) 9-Hr. Simulator | | (C) 6-Hr. Simulator | | (D) 3-Hr. Simulator | | (E) Accelerated Non-Simulator | | F Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std.Dev. | Mean | Std.Dev. | Mean | Std.Dev. | Mean | Std.Dev. | Mean | Std.Dev. | |
| Age in Months | 197.31 | 8.46 | 196.80 | 7.18 | 197.02 | 5.65 | 199.79 | 5.55 | 195.80 | 8.86 | 2.092 |
| Hours of Outside Driving | 3.52 | 4.21 | 2.86 | 3.49 | 1.49 | 5.22 | 3.50 | 4.00 | 1.84 | 4.07 | .615 |
| IQ | 105.91 | 15.41 | 107.38 | 14.41 | 105.70 | 13.52 | 106.60 | 12.33 | 102.83 | 18.07 | 1.774 |
| Grade Average* | 75.75 | 8.21 | 76.75 | 8.44 | 75.19 | 7.03 | 75.42 | 7.45 | 72.26 | 9.60 | 1.714 |
| Harrisburg Pre-Knowledge Test | 31.87 | 5.10 | 32.86 | 4.23 | | | | | | | 3.328 |
| AAA Pre-Knowledge Test | 11.16 | 2.81 | 11.10 | 2.79 | | | | | | | .032 |
| Siebrecht Attitude Test | 27.12 | 6.10 | 27.25 | 5.92 | | | | | | | .039 |

*Sophomore grade average in all school subjects

## APPENDIX D (CONTINUED)

### TABLE I

### AGE IN MONTHS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 472.67843 | 118.16960 | 2.09225 |
| Within | 472 | 26,658.35721 | 56.47957 | |
| Total | 476 | 27,131.03564 | | |

### TABLE II

### HOURS OF OUTSIDE DRIVING

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 44.34273 | 11.08568 | .61544 |
| Within | 472 | 8,501.84595 | 18.01238 | |
| Total | 476 | 8,546.18868 | | |

### TABLE III

### IQ

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 1,574.69 | 393.67250 | 1.77434 |
| Within | 472 | 104,722.31 | 221.86930 | |
| Total | 476 | 106,297 | | |

### TABLE IV

### GRADE AVERAGE

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 464.33075 | 116.08268 | 1.71438 |
| Within | 472 | 31,959.59378 | 67.71100 | |
| Total | 476 | 32,423.92453 | | |

## APPENDIX D (CONTINUED)

### TABLE V

### HARRISBURG PRE-KNOWLEDGE TEST

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | 73.79 | 73.79 | 3.328 |
| Within | 304 | 6,735.49 | 22.16 | |
| Total | 305 | 6,809.28 | | |

### TABLE VI

### AAA PRE-KNOWLEDGE TEST

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | .24 | .24 | .032 |
| Within | 304 | 2,382.54 | 7.84 | |
| Total | 305 | 2,382.78 | | |

### TABLE VII

### SIEBRECHT ATTITUDE TEST

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | 1.41 | 1.41 | .039 |
| Within | 304 | 10,982.97 | 36.13 | |
| Total | 305 | 10,984.38 | | |

# APPENDIX E

## STATISTICAL DATA AND ANALYSIS

### ANALYSIS OF VARIANCE

TABLE I

FOURTH PERIOD STEERING ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatments | 4 | 2,375.18 | 593.80 | 4.57 |
| Within | 472 | 61,336.82 | 129.95 | |
| Total | 476 | 63,712. | | |

TABLE II

FOURTH PERIOD BRAKE ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 346.39 | 86.60 | 2.85 |
| Within | 472 | 14,329.27 | 30.36 | |
| Total | 476 | 14,675.66 | | |

TABLE III

FOURTH PERIOD TURN SIGNAL ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 2.69237 | .67309 | .78596 |
| Within | 472 | 404.21749 | .85639 | |
| Total | 476 | 406.90986 | | |

TABLE IV

FOURTH PERIOD SPEED ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 299.51 | 74.88 | 6.08 |
| Within | 472 | 5,810.26 | 12.31 | |
| Total | 476 | 6,109.77 | | |

TABLE V

FOURTH PERIOD TOTAL ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 8,185.80 | 2,046.45 | 7.14 |
| Within | 472 | 135,329.15 | 286.71 | |
| Total | 476 | 143,514.95 | | |

TABLE VI

FINAL PERIOD STEERING ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 404.92 | 101.23 | 2.87 |
| Within | 472 | 16,657.33 | 35.29 | |
| Total | 476 | 17,062.25 | | |

TABLE VII

FINAL PERIOD BRAKE ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 24.54 | 6.14 | .57 |
| Within | 472 | 5,080.18 | 10.76 | |
| Total | 476 | 5,104.72 | | |

TABLE VIII

FINAL PERIOD TURN SIGNAL ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 3.40031 | .85007 | .28869 |
| Within | 472 | 1,389.80724 | 2.94450 | |
| Total | 476 | 1,393.20755 | | |

TABLE IX

FINAL PERIOD SPEED ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 18.31 | 4.58 | .25 |
| Within | 472 | 8,497.35 | 18.00 | |
| Total | 476 | 8,515.66 | | |

TABLE X

FINAL PERIOD TOTAL ERRORS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 961.58 | 240.40 | 1.6 |
| Within | 472 | 70,795.33 | 149.99 | |
| Total | 476 | 71,756.91 | | |

## ANALYSIS OF COVARIANCE

### TABLE XI

### AAA PRE-POST KNOWLEDGE TEST

| Source of Variation | Degrees of Freedom | $x^2$ | xy | $y^2$ |
|---|---|---|---|---|
| Treatment | 1 | .24 | 1.00 | 4.31 |
| Within | 304 | 2,382.54 | 1,085.31 | 2,207.13 |
| Total | 305 | 2,382.78 | 1,086.31 | 2,211.44 |

| Source of Variation | Degrees of Freedom | Sum of Squares for Residuals | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | 2.36 | 2.36 | .42 |
| Within | 303 | 1,713.56 | 5.66 | |
| Total | 304 | 1,716.20 | | |

### TABLE XII

### HARRISBURG PRE-POST KNOWLEDGE TEST

| Source of Variation | Degrees of Freedom | $x^2$ | xy | $y^2$ |
|---|---|---|---|---|
| Treatment | 1 | 73.79 | 41.53 | 23.37 |
| Within | 304 | 6,735.49 | 3,249.96 | 7,026.58 |
| Total | 305 | 6,809.28 | 3,291.49 | 7,049.95 |

| Source of Variation | Degrees of Freedom | Sum of Squares for Residuals | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | .46 | .46 | .03 |
| Within | 303 | 5,458.44 | 18.01 | |
| Total | 304 | 5,458.90 | | |

TABLE XIII

SIEBRECHT PRE-POST ATTITUDE SCALE

| Source of Variation | Degrees of Freedom | $x^2$ | xy | $y^2$ |
|---|---|---|---|---|
| Treatment | 1 | 1.41 | -7.63 | 41.19 |
| Within | 304 | 10,982.97 | 5,451.20 | 11,461.89 |
| Total | 305 | 10,984.38 | 5,443.57 | 11,503.08 |

| Source of Variation | Degrees of Freedom | Sum of Squares for Residuals | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | 49.11 | 49.11 | 1.699 |
| Within | 303 | 8,756.28 | 28.90 | |
| Total | 304 | 8,805.39 | | |

TABLE XIV

ADJUSTED HAYES SCALE

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 1 | 95.74990 | 95.74990 | 3.64400 |
| Within | 304 | 7,987.91350 | 26.27603 | |
| Total | 305 | 8,083.66340 | | |

TABLE XV

ANALYSIS OF VARIANCE STATE SKILLS TEST

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 6.18 | 1.55 | 2.981 |
| Within | 465 | 240.15 | .52 | |
| Total | 469 | 246.33 | | |

TABLE XVI

ANALYSIS OF VARIANCE STATE WRITTEN TEST

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Treatment | 4 | 1.97672 | .49418 | 3.115 |
| Within | 468 | 74.24739 | .15864 | |
| Total | 472 | 76.22411 | | |

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